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II. The influence of intermittent freezing and thawing upon *B. coli*.

If crystallization is in some way effective in destroying germ life, then alternate freezing and thawing should bring about a greater reduction than prolonged freezing. Table I. shows a part of one of our protocols. It will be noted that intermittent freezing has but slightly greater germicidal value than has sustained freezing for the same period of time.

III. The effect of the degree of cold used in the freezing mixture.

Tubes containing the bacteria were frozen and held for three hours for comparison at approximately -15° C. and -2° C. The colder temperature was considerably more fatal. Tubes kept at $+5^{\circ}$ C., used as controls in most of the experiments, showed marked variation, but seldom showed over 30 per cent. to 40 per cent. of the bacteria to be killed.

IV. The composition of the media and its influence upon germ survival in freezing mixtures.

It was with the object of studying this feature of the work that we began our experiments. They are still very deficient, but what we have found is worthy of consideration.

Distilled water and Boston tap water give very uniform and comparable results.

Using cream containing 30 per cent. of butter fat, we found very striking protection afforded the bacteria when frozen, whether the freezing be continuous or intermittent. Held at just above the freezing temperature, we find about the same percentage reduction to occur as in water, though the results are very erratic, occasionally showing an increase during the course of a few hours. Freezing and thawing at intervals is considerably more fatal than continuous freezing. A few typical results of freezing *B. coli* in cream are given in the second table.

It is premature to suggest conclusions but our results lead us to infer that the degree of cold, time of freezing, crystallization and external pressure, and the composition of the media in which the freezing occurs all have

an influence upon the germicidal potency exhibited by cold. Probably all of the explanations for the mode of destruction, suggested in the early part of these notes, must be considered as important.

TABLE I

A Comparison of the Percentage Reduction of B. coli held at 5° C., -15° C., and Frozen Intermittently for a Three-hour Period

Initial Count	First Freezing	Second Freezing	Third Freezing	Fourth Freezing	Freezing 3 Hours	Cold 3 Hours
2130	82.2%	99.9%	99.9%	99.9%	99.9%	23.0%
1670	92.8	96.1	99.8	99.9	99.7	29.0
1320	93.8	98.7	99.9	99.9	99.4	47.0
3015	97.6	99.6	99.5	99.9	99.8	31.3
4800	98.6	99.4	99.8	99.8	99.8	32.0
1370	98.6	99.5	99.8	99.9	99.7	8.1
1070	97.9	99.5	99.5	99.9	99.9	97.3

TABLE II

Percentage Reduction Obtained with B. coli in Cream at Freezing Temperatures

Initial Count	First Freezing	Second Freezing	Third Freezing	Fourth Freezing	Freezing 3 Hrs. 0° C.	Cold 3 Hrs. 5° C.
4350	4.8%	39.3%	45. %	48.9%	61.3%	18.6%
4740	40.5	45.5	71.5	75.9	67.7	42.7
5275	43.1	46.7	71.9	81.2	44.2	16.4
5284	33.4	48.2	60.2	—	26.4	20.8
5028	32.2	36.2	48.4	71.7	34.8	20.6
3732	35.2	20.9	42.3	50.1	33.6	38.9
4030	71.0	67.1	78.6	83.1	67.6	3.9
5085	21.1	51.6	53.3	75.4	65.3	23.8
4725	16.1	36.5	52.2	72.6	58.0	16.8
4560	34.8	47.1	67.4	63.8	54.2	19.7

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SOCIETIES AND ACADEMIES

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—SECTION OF EDUCATION

THE special summer session of Section L, Education, of the American Association for the Advancement of Science met at the University of California on Tuesday, August 3, and at Stanford University on the following day. The morning meeting on Tuesday was a joint meeting with

Section H and the American Psychological Association. The general subject of the Section's meetings was, "The Scientific Study of Educational Problems."

The joint meeting on Tuesday has already been reported by Dr. J. E. Coover for the American Psychological Association,¹ and need not be reviewed here again. It is worth while noting, however, that the papers all dealt with the application of psychological tests to various groups of individuals. Drs. Grace M. Fernald and Olga L. Bridgman were interested in delinquents; Professor Louis N. Terman in extending the Binet tests; Professor Kate Brousseau in the feeble-minded; Mrs. V. C. Hicks and Dr. J. E. W. Wallin in mental defectives in the schools; Professor Eleanor Rowland in intelligence tests for college students, and Mr. LeRoy W. Fike in tests for stenographers.

In the afternoon President Wm. T. Foster reported the system of scientific grading in operation at Reed College and explained how credit was awarded for varying grades of quality in the work of the students. Mr. Chas T. Luthy, of Peoria, Ill., reported in considerable detail the mechanism of human speech sound and urged that greater attention be paid this subject, especially on the part of primary and language teachers, so that they might more intelligently understand the mistakes made by their pupils and know how to correct them. The paper by Mr. Walter B. Swift, of Boston, on the "Management of the Speech Defect Problem in the Public Schools" was read by Professor Terman. The acting-secretary read the paper of Mr. Wm. Kent, of Montclair, N. J., on "Elements in the Teaching of Writing." In this paper the writer calls attention to the fact that the difficulty in learning to write is as much due to lack of training of the eye to see errors as it is to lack of ability in executing movements with the hand. He suggested a number of simple exercises by which the eye might be trained in noting defects and in guiding simple movements of the hand before actual practise in writing commenced. Professor Paul H. Hanus's paper, "Measuring Progress in Latin" was also read by the acting-secretary. His paper was a preliminary report on the development of three tests which might indicate progress in Latin. These tests covered vocabulary, grammar and translation. The general scheme was to prepare such tests as might

be applied to first-year students and then to have them given in each of the four high-school years. Mr. Wilford E. Talbert called attention in his paper on the "Principal's Study Club of Oakland, Calif.," to what could be done in the way of cooperative research work in a public-school system—Dr. Sears's work, reported below, being mentioned as one example. The program for the day was completed by a paper on "The Vitalizing Principle in Education," by Professor Edward J. Kunze, of the Oakland Agricultural and Mechanical College.

After a very enjoyable morning spent in visiting Stanford University where all were most hospitably entertained, the Section held its concluding session on Wednesday afternoon. Dr. L. W. Sackett, of the University of Texas, presented a very interesting paper on "Measuring a School System by the Buckingham Spelling Scale" in which he showed objectively each school system's standing in spelling—also the standing of each department and grade of each school system. Dr. L. B. Sears, of Stanford University, reported on the "Spelling Efficiency in the Oakland Schools." His general conclusion was that there was no standardization at all. Professor L. Edgar Coover called attention to several of the technical difficulties which still confuse the whole problem of "Formal Discipline." Professor Edward K. Strong, Jr., of George Peabody College for Teachers, reported on several cases in which special instruction had been given fourth-grade children in arithmetic with the result that the children had gained noticeably not only in arithmetic but in other subjects—the gain being due to changes in the child's attitude toward himself. It was suggested that learning curves in arithmetic be employed for this particular purpose. Dr. David S. Hill's paper was a "Survey of Industries in Mechanical Occupations in New Orleans by the Division of Educational Research." Several points were presented dealing with the relationship between occupational needs and industrial and vocational education. He also reported on the work being done in New Orleans in handling the defective child. Mr. Geo. E. Hall, describing an interesting study being made in the Schenectady high schools on "High-school Non-Promotions and Some Factors that Affect them," brought out the point that non-promotion is due not only to incapacity but in many cases to outside interests such as society, clubs or the need to earn money.

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¹J. E. Coover, Report of Secretary of Committee on Program for San Francisco meeting of the American Psychological Association, *Psychol. Bull.*, September, 1915, 12, 313-332.